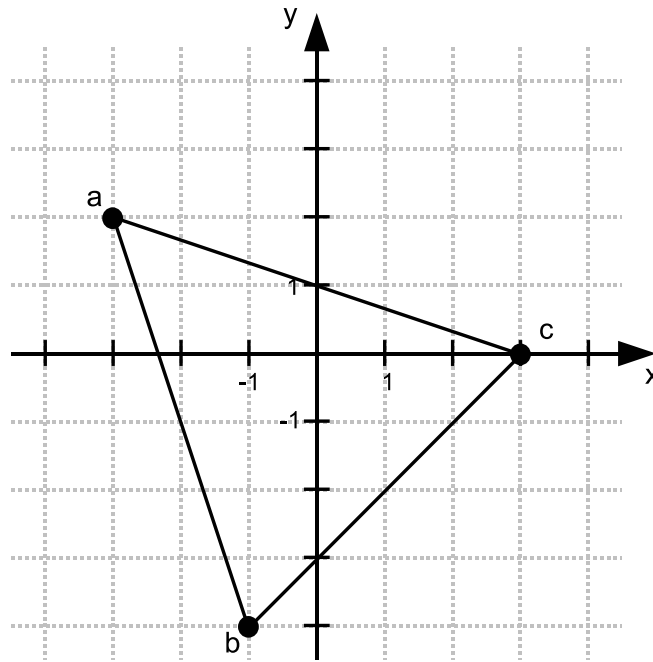


Exercise 1
Data Analysis and Visualization
Computer Graphics - Transformation

Task 1

Given the triangle formed by the 2D points $\vec{a} = (-3, 2)$, $\vec{b} = (-1, -4)$, and $\vec{c} = (3, 0)$, the following three transformations are consecutively applied to the triangle.

- (i) Rotation by -90° .
 - (ii) Translation by $(2, 1)$.
 - (iii) Scaling by $\frac{1}{2}$.
- (a) Draw the triangle after each transformation step.
- (b) Consecutively apply the transformations to \vec{a} .
- (c) Write down the three individual transformation matrices in homogenous coordinate form, and combine them into a single matrix.
- (d) Apply the combined transformation to all three points.

Task 2 A triangle consisting of three 3D-points \vec{a} , \vec{b} , and \vec{c} was transformed in four steps:

- (i) Rotated by 45° around x.
- (ii) Scaled by $(1, \frac{1}{3}, 1)$.
- (iii) Translated by $(3, -\sqrt{2}, 0)$.
- (iv) Rotated by -45° around x.

which leads to the current points $\vec{a}_M = (1, 0, 0)$, $\vec{b}_M = (-1, 2, 2)$, and $\vec{c}_M = (3, 0, -4)$. In order to find the triangle's vertex positions before the transformations, we have to apply *inverse* transformations to these points.

- (a) Write down the four individual transformation matrices.
- (b) Calculate the inverse of the combined transformation.
- (c) Apply the inverted combined transformation to all three points.